Multi-drop vehicle routing problem with safety constraints

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December 17, 2015

Abstract

Transportation companies often combine cargo delivery to multiple customers. This enables transporters to reduce the number of vehicles and to transport full truck loads as much as possible. Transporters need to deliver the goods to the right place within a certain time window, in a cost-effective way and without potential damage to the vehicle, to the cargo itself or to other road users. Combining the cargo for different customers in one vehicle is an important measure to help them meet all these requirements.

However, problems combining cargo for multiple customers are subject to multi-drop constraints, which prevent additional cargo handling at drop-off points. Such constraints minimize the potential for loading scheme optimization, due to the fact that they require taking into account the unloading sequence.

While the vehicle routing problem is one of the most academically studied combinatorial optimization problems, the problem of dynamic cargo stability has never been addressed via a decision support-based approach. Loading scheme safety is traditionally appraised by rules of thumb, both by the carrier and authorities.

We propose a decomposition-based approach for solving the combined problem, minimizing both route cost and loading scheme cost. Only solutions respecting cargo security constraints are considered. Loading scheme costs are determined by additional securing methods required for safety. Datasets have been generated along with benchmark results obtained by the algorithm.

Keywords: vehicle routing, container loading, decomposition, sequential loading, cargo safety

Acknowledgments.

Work supported by the Belgian Science Policy Office (BELSPO) in the Interuniversity Attraction Pole COMEX (http://comex.ulb.ac.be) and by VIL (IWT-130777).